

Appl. No 09/470,787
Amendment dated December 19, 2003

Amendments to the Claims:

This listing of claims will replace all prior version, and listings, of the claims in the application:

Listing of Claims:

1. (currently amended) A system for controlling traffic congestion within a buffered data switching network having a predetermined total buffer size, said system comprising:
 - (a) a packet counter for counting a number of newly arriving packets in the switching network; and
 - (b) calculation means for calculating an average queue size, \bar{Q}_t , at time t as

$$\bar{Q}_t = \bar{Q}_{t-1} \times (1 - Alpha) + Q_t \times Alpha$$

where Q_t is an instantaneous queue size, \bar{Q}_{t-1} is the average queue size at time $t-1$, and $Alpha$ is a queue-length averaging parameter;

- (c) threshold means for setting a packet-count threshold in accordance with the average queue size, for discarding a packet when the number of newly arriving packets reaches the packet-count threshold and when the average queue size exceeds a congestion threshold, and for resetting the packet counter when a packet is discarded. [[:]]

2. (cancelled)

- 2/3. (currently amended) [[A]] The system as in claim 1, wherein the calculation means includes means to regularly updates the average queue size using an exponential averaging technique.

- 3/4. (currently amended) [[A]] The system as in claim 1, wherein $Alpha$ is assigned a value between zero and one.

- 4/5. (currently amended) [[A]] The system as in claim 1, wherein a progressively increasing value of $Alpha$ is assigned with increasing level of traffic congestion.

- 5/6. (currently amended) [[A]] The system as in claim 4, wherein the level of traffic congestion is indicated by the instantaneous queue size.

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- 6/1. (currently amended) [[A]] The system as in claim 1, wherein the average queue size is updated after a predetermined number of cells have arrived since a previous packet discard.
- 7/8. (currently amended) [[A]] The system as in claim 1, wherein the average queue size is updated after a predetermined period of time has elapsed since a previous packet discard.
- 12/9. (currently amended) A system for controlling traffic congestion within a buffered data switching network having a predetermined total buffer size the data switching network having a queue with a queue size, said system comprising:
- (a) a packet counter for counting a number of newly arriving packets in the switching network; and
 - (b) calculation means for calculating an average queue size; and
 - (c) threshold means for dividing the total queue size into a pre-selected number of N regions, for setting a packet-count threshold in accordance with the average queue size by using a descending staircase function $F(n)$, for discarding one of every $F(n)$ packets when the average queue size is in a buffer region n , $1 \leq n \leq N$ and for resetting the packet counter when a packet is discarded.
- 13/10. (currently amended) [[A]] The system as in claim ¹²9, further comprising means for detecting traffic congestion by setting a congestion threshold and comparing the average queue size with the congestion threshold, such that a congestion condition is indicated by the average queue size being equal to or above the congestion threshold, and an absence of congestion is indicated otherwise.
- 14/11. (currently amended) [[A]] The system as in claim ¹³10, wherein the packet is discarded only during the congestion condition.
- 15/12. (currently amended) [[A]] The system as in claim ¹³10, wherein the packet counter begins to operate when traffic congestion is detected, and halts operation when an absence of traffic congestion is detected.
- 16/13. (currently amended) [[A]] The system as in claim ¹²9, wherein the threshold means further includes means for dividing the total queue size into a pre-selected number of M regions, for high-priority traffic defining a high-priority congestion threshold, and the pre-selected number of N regions for low-priority traffic defining a low-priority congestion

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threshold, wherein the threshold means sets the packet-count threshold by using two functions $F(n, m)$ and $F(m)$, such that:

when the average queue size of high-priority traffic is above the high-priority congestion threshold and is in the buffer region m , $1 \leq m \leq M$, one of every $F(m)$ high priority packets is discarded; and

when the average queue size of low-priority traffic is above the low-priority congestion threshold and is in the buffer region n , $1 \leq n \leq N$, one of every $F(n, m)$ low priority packets is discarded.

¹⁷
~~14~~ (currently amended) ¹⁶[[A]] The system as in claim ~~13~~, wherein the function $F(m)$ is a descending staircase function in the buffer region m , and the function $F(n, m)$ is a multivariable function of m and n , which has a descending staircase behaviour in the buffer region n for a fixed value of m .

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~~15~~ (currently amended) ⁹[[A]] The system as in claim 1, further comprising means for applying a priority scheme for discarding packets, which provides a differentiated service among service classes sharing a common buffer.

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~~16~~ (currently amended) ¹⁰[[A]] The system as in claim 1, wherein the threshold means uses a look-up table.

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~~17~~ (currently amended) ¹¹[[A]] The system as in claim 1, wherein the threshold means sets the packet-count threshold upon arrival of a new packet into the system.

¹¹
~~18~~ (currently amended) ¹²[[A]] The system as in claim 1, wherein the threshold means sets the packet-count threshold upon departure of a packet from the system.

¹²
~~19~~ (previously amended) A method for controlling traffic congestion within a buffered data switching network having a predetermined total buffer size, said method comprising the steps of:

- (a) counting a number of newly arriving packets;
- (b) calculating an average queue size wherein the average queue size at time t is calculated as:

$$\bar{Q}_t = \bar{Q}_{t-1} \times (1 - Alpha) + Q_t \times Alpha$$

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where Q is an instantaneous queue size, \bar{Q}_{i-1} is the average queue size at time $i-1$, and

α is a queue-length averaging parameter;

- (c) setting a packet-count threshold; and
(d) discarding a packet and ^{restarting the counting of newly arriving packets} resetting the packet count, when the number of newly arriving packets reaches the packet-count threshold and the average queue size exceeds a congestion threshold.

20. (cancelled)

19/21. (currently amended) ¹⁸[[A]] The method as in claim 19, wherein the calculating step regularly updates the average queue size using an exponential averaging technique.

22. (currently amended) ¹⁸[[A]] The method as in claim 19, wherein α is assigned a value between zero and one.

23. (currently amended) ¹⁸[[A]] The method as in claim 19, wherein a progressively increasing value of α is assigned with increasing level of traffic congestion.

24. (currently amended) ¹⁸[[A]] The method as in claim 23, wherein the level of traffic congestion is indicated by the instantaneous queue size.

20/25. (currently amended) ¹⁹[[A]] The method as in claim 21, wherein the average queue size is updated after a predetermined number of cells have arrived since a previous packet discard.

21/26. (currently amended) ¹⁹[[A]] The method as in claim 21, wherein the average queue size is updated after a predetermined period of time has elapsed since a previous packet discard.

26/27. (currently amended) A method for controlling traffic congestion within a buffered data switching network having a predetermined total buffer size, said method comprising:

- (a) counting the a number of newly arriving packets;
(b) calculating an average queue size;
(c) dividing the predetermined total buffer size into a pre-selected number of N regions;
(d) setting a packet-count threshold in accordance with a descending staircase function

$F(n)$ and λ

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(e) discarding one of every $F(n)$ packets and ^{starting the counting of newly arriving packets} resetting the packet count, when the average queue size is in a buffer region n , $1 \leq n \leq N$.

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28. (currently amended) [[A]] The method as in claim 27, further comprising a step of detecting traffic congestion by setting a congestion threshold and comparing the average queue size with the congestion threshold, such that a congestion condition is indicated by the average queue size being above the congestion threshold, and an absence of congestion is indicated otherwise.

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29. (currently amended) [[A]] The method as in claim 28, wherein the packet is discarded only during the congestion condition.

30. (currently amended) [[A]] The method as in claim 28, wherein the packet counter begins to operate when traffic congestion is detected, and halts operation when an absence of traffic congestion is detected.

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31. (currently amended) [[A]] The method as in claim 27, wherein the step of dividing the predetermined total buffer size includes dividing the predetermined total buffer size into both a pre-selected number of M regions, for high-priority traffic defining a high-priority congestion threshold, and a pre-selected number of N regions for low-priority traffic defining a low-priority congestion threshold, wherein the step of setting the packet-count threshold sets the packet-count threshold by using two functions $F(n,m)$ and $F(m)$, and wherein the step of discarding includes discarding one of every $F(m)$ high priority packets when the average queue size of high-priority traffic is above the high-priority congestion threshold and is in the buffer region m , $1 \leq m \leq M$, and discarding one of every $F(n,m)$ low priority packets when the average queue size of low-priority traffic is above the low-priority congestion threshold and is in the buffer region n , $1 \leq n \leq N$.

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32. (currently amended) [[A]] The method as in claim 31, wherein the function $F(m)$ is a descending staircase function in the buffer region m , and the function $F(n,m)$ is a multivariable function of m and n , which has a descending staircase behaviour in the buffer region n for a fixed value of m .

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33. (currently amended) ¹⁸[[A]] The method as in claim 18, further comprising a step of applying a priority scheme for discarding packets, which provides a differentiated service among service classes sharing a common buffer.
